Revealing distances to diffuse emission observed in LoTSS data

Abstract

We performed Faraday tomography on very low-resolution polarised observations of LOFAR Two-metre Sky Survey second data release (LoTSS-DR2) for a great part of the northern sky (3100 degrees squared, Erceg+ 2022). In this talk I will present the multi-tracer analysis of the LoTSS mosaic, focusing on the correlation between the magnetic field traced by dust, HI filaments, stellar polarisation and linear depolarised structures (depolarisation canals) observed in low-frequency polarisation. Correlation between these tracers was previously observed in several smaller LOFAR fields (Jelić+ 2018, Bracco+ 2020), where it was used to analyse the 3D spatial distribution of diffuse ionised medium probed by LOFAR (Turić+ 2021). In this work, we extend the multi-tracer analysis to a much larger area than previously available to determine if the alignment between different ISM phases and depolarisation canals is a common occurrence or an exception. Additionally, in areas where depolarisation canals align with the magnetic field, we use stellar polarisation data to set limits to the distance of structures that create depolarisation canals. We found a significant correlation between the magnetic field, depolarisation canals and HI filaments in the Western region of the LoTSS mosaic. Based on this alignment, we estimated the lower and upper limits to diffuse emission observed by LOFAR in this region to be 230 and 250 pc, with an error of 50 pc. These distances correspond to the expected distance to the Local Bubble in the observed direction.